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Comparative Study on Strength Behaviour of Falg Concrete with Conventional Concrete

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Abstract

Conventional concrete is responsible for the amount of CO_2 emission to some extent. You can lessen the emission. Various concrete varieties have evolved the use of waste materials from manufacturing enterprises and farms use like blast furnace slag, silica fume, fly ash. They require a very less amount of energy. They also motive very less harm to our surrounding environment. Falg concrete is an emerging technology advanced to reduce the environment's effect by the cement manufacturing process. Cement includes the excessive quantity of Co_2 which harms the surroundings substantially, so by replacement of cement by using numerous substances which causes damage to the surrounding environment we no longer most effectively reduce the problem of disposal of those materials but we reduce the emission of carbon-di-oxide from cement. This study concerns with the usage of fly ash and lime to improve the strength of concrete. In our project, we are replacing cement with falg by 0%. 10% and 20% for M_{30} grade concrete. This undertaking aims to research the compression strength, Tensile strength, and water absorption of M_{30} grade concrete.

I. INTRODUCTION

Cement is one of the main parts of concrete. The assembly of 1 ton of cement releases one ton of Co_2 emissions into the atmosphere. Greenhouse emission is thought to be inexperienced house gas that contributes to global warming. The reduction in Co_2 emission from concrete is often achieved with the substitution of cement partially by the varied supplementary cementations materials. The employment of those cementations materials has resulted in an improvement of the properties of concrete. Thus to cut back on this environmental impact, green concrete plays an important role.

Using recycled materials or waste materials that are harmful to the environment as the placement of cement-like ash, silicon oxide flume, etc. we can reduce the greenhouse emission of Co2 gas from concrete moreover because it decreases the environmental hazardous on earth. As a result of this, green concrete is among the main tools in the future when natural resources are on the verge of extinction.

Fly ash could be a residual material of energy production using coal that has been found to possess various benefits to be used in concrete. A number of the advantages include improved workability, reduced permeability, increased ultimate strength, reduced bleeding, better surface, and reduced hydration heat. Many varieties of ash are produced depending on the coal and coal combustion method. Fly ash is one among the leftover material produced in the burning process and contains the fine particle which raises flue gases. Ash that doesn't rise is termed as bottom ash. In an industrial context, ash sometimes refers to ash produced throughout the combustion of coal. Ash is usually captured by electrostatic precipitators or alternative particle filtration instrumentation before the gases reach the smokestack, referred to as coal ash. Fly ash is typically free from the atmosphere. However, pollution management instrumentation man dated in recent decades currently needs that it's captured before unharness. In the US, ash is usually holding on at fuel power stations. Sometimes ash will be dumped in landfills. Concerning 43% is recycled, typically wont to supplement cement in concrete production. In some cases, like the burning of solid waste to form electricity, ash might contain greater levels of impurities than bottom ash, and the combination of fly and bottom ash along brings the percentage levels of contaminants inside the vary to qualify as non-hazardous waste in a very given state, whereas, unmixed, fly ash would be inside the vary to qualify as dangerous waste.

II. LITERATURE REVIEW

A. P. Meenaksh (2017) studied partial replacement of cement by barites and lime powder in concrete. This paper design concrete mix is M30 grade of concrete. The cement is a partial replacement of barites and limestone powder as the percentages are 0%, 10%, 20%, and 30% were used in this investigation. The replaced materials are increased the compressive strength in the initial period at 7 days and 14 days, and also the same result was obtained.

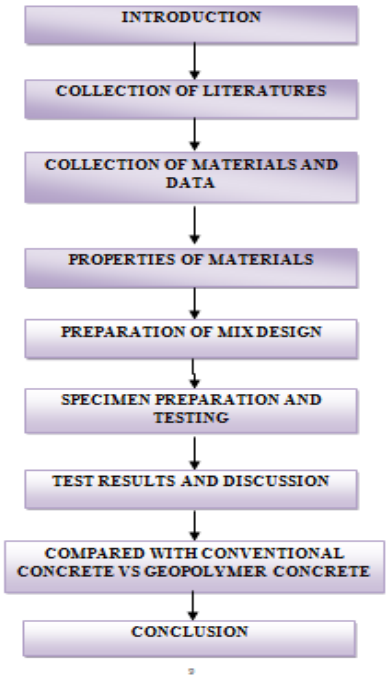
The experimental investigation does not show increases in the compressive strength in 28 days.

B. S. Sudha (2016) studied the durability and strength characteristics of concrete using lime sludge and fly ash as partial replacement of fine aggregate in this paper design the concrete mix. Present the construction use the waste materials fly ash, lime sludge, etc. this material is very low cost. The cement is replaced b lime sludge, and the fine aggregate is replaced by fly ash. The percentages of lime sludge are 0%, 5%, 10% and 15%. Flyash is 0% and 5%. To determine the compressive strength, flexural, and split tensile strength at 7 days and 28 days.

C. Swati Chadel, Ajay K Duggal, and Naiyara Khan (2016) studied on to study the effect of partial replacement of lime by cement in mastic asphalt. In this paper investigate the mastic asphalt is grained material it is using the construction work because it's high durability, higher stability, and low cost. The partial replacement of lime b cement at percentages is 3%, 6%, 9%, 12%, and 15% in the mix. The mastic asphalt sample was prepared with and without coarse aggregate to given percentages. Industrial grade bitumen was used in the binder, and stone dust was used as fine aggregate size from 2.36mm to19mm used the coarse aggregate in this work. It observed that the specimens without coarse aggregate values satisfy the proposition < 9% with coarse aggregate the maximum replacement possible is 12%.

D. W. Gudissa and A. Dinku Studied the use of limestone powder as an alternative cement replacement material in an experimental study. This paper investigates the limestone powder addition of the cement paste's physical and chemical properties and hardened concrete. The OPC replacement of limestone powder is 5% to 10% satisfied the standard compressive strength of high early strength of cement is 42.5Mpa. The replacement of cement clinkers b limestone filter is 15%-20% satisfied the compressive strength of early strength of 32.5Mpa. Limestone powder is weighed to the clinker from 25%-32% is slightly higher at 28 days of standard compressive strength.

III. METHODOLOGY



IV. MATERIALS COLLECTION

A. Concrete

Concrete is a building material that consists of cement, fine aggregates, coarse aggregates, and water. It consists of some amount of air voids and may contain purposely-entrained air using air-entraining admixtures. Different chemical admixtures and finely packed mineral admixtures are mostly used in concrete production to enhance or change concrete properties in a frugal way.

B. Cement

Cement is a general term that can suit all binders. In construction industries, different types of cement are used to solve problems. Cement with different chemical compositions is available in the market. But now a day, Portland cement is generally used in the construction field.

Table 1 Properties of cement

S.no	**Properties**	**Test results**
1	Normal consistency	0.32
2	Initial setting time	50min
3	Final setting time	320min
4	Specific gravity	3.14
5	Fineness	5%

Fig 1 Cement

C. Aggregate

Aggregate sizes of 20 mm are used in this experimental study, and the relative density value of 2.78 and modulus of fineness of 7 was obtained. Aggregates were collected from our surrounding locations. They are obtained from topically available crushed granite stones. The size of aggregate is 20 mm, which conforming as per code IS: 383 – 1970. The crushed granite aggregates having a specific gravity of 2.77, which doesn't retain through 4.75 mm IS sieve, and it is used for specimen castings. Many investigations finalized that the size of coarse aggregate plays a major role in the strength of concrete. Along with the ratio of cement paste & aggregate, the type of aggregate has a very great influence on concrete stability.

Fig 2 Coarse Aggregate

Properties	Coarse aggregate
Particle shape	Angular
Particle size	20mm
Specific gravity	2.75
Bulk density	1340 kg / m^3
Fineness modulus	4.18

Table 2 Properties of coarse Aggregate

D. Fine aggregate

Locally available fine aggregates that passes through a 4.75mm IS sieve is used. The relative density of sand was obtained as 2.60. Topically available river sand which conforms to zone I of IS: 383 –1970. Locally available clean, dry sand is used for this purpose. For casting specimens, fine aggregate passes through a 4.75 mm IS sieve was used.

Fig 3 Fine Aggregate

Properties	Magnitude
Specific gravity	2.6
Bulk density ,kg/m^3	1830
Porosity,%	29.67
Grading zone	Zone II
Fineness modulus	3.13
Water absorption	1.02%

Table 3 Property of Fine Aggregate

E. Water

The water used for this experimental study was potable. Water plays a major role in concrete as it actively contributes to the chemical reaction with cement. It should be free from organic matter, and the pH value ranges from 6 to 7.

PROPERTIES OF WATER

- The pH value shall not be less than 6.
- Role of Water in Cement Concrete
- The need for water used in concrete
- The allowable limits for solids in water
- Solids Permissible Limits (Max)
- Organic compounds 200 mg/lit
- Inorganic compounds 3000 mg/lit
- Sulfates (SO_4) 500 mg/lit
- Chlorides (Cl) 500 mg/lit
- Suspended matter 2000 mg/lit Water/Cement Ratio and Strength.

F. Fly ash

In electrical power generation plants, Ash is a leftover material of the burning process of powdered coal. Carbon and volatile materials will be burned off during this combustion

process, and some mineral impurities will be left in the combustion chamber. The fused materials will be solidified into glassy particles because of the cooling process of exhaust gases. Those particles are called as Fly ash. Due to the fusion process, they are generally tiny solid particles that may contain smaller spheres.

The particle size of fly ash is almost similar to that of ordinary Portland cement. From fume gases, the fly ash is collected through electrostatic precipitators.

Fig 4 Flyash

G. Lime powder

Lime powder is a basic building material. In construction, it is used as a lime mortar. The properties and their uses are discussed here.

There are two categories of lime. One is non-hydraulic, and the other is hydraulic lime. Other names of non-hydraulic lime are quick lime. Hydraulic lime will sets underwater, whereas non-hydraulic lime doesn't set underwater.

Fig 5 Lime powder

Chemical name	Calcium hydroxide
Physical appearance	Dry white powder
Boiling temperature (^{0}C)	100
Heat of fusion(^{0}C)	580
Bulk density (kg/m^3)	Max. 500
Specific gravity	1.2–1.5
pH (25^{0}C)	12.4
$Ca(OH)_2$ (%)	80–86

Table 4 Properties of Lime powder

H. Gypsum

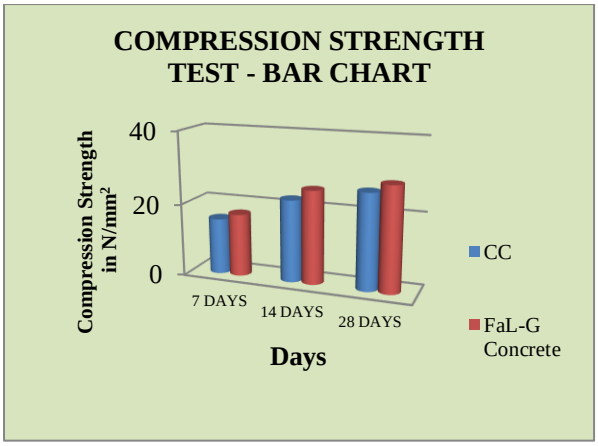
Gypsum is a smooth sulfate mineral that consists of calcium sulfate dehydrate composition. Its chemical formula is $CaSO_4 \cdot 2H_2O$. It is broadly mined and used as a fertilizing agent, and it plays a vital role in plastering, blackboard chalk, wallboard, etc. A huge fine-grained white gypsum, which is also called alabaster, is used in many sculptures by many cultures. They may include Ancient Egypt, Mesopotamia, etc., the hardness of the material is found out by Mohr's scale, which defines the hardness value of gypsum as 2. It produces a hydration product named anhydrite as a evaporate minerals.

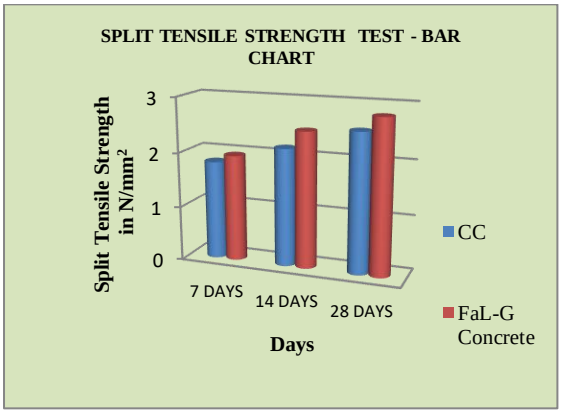
Fig 6 Calcined Gypsum

V.TEST RESULTS

A. Compression and split tensile test result

S.NO	NAME OF THE TEST	SPECIMEN	DAYS	DATE OF TESTING	LOAD IN (kN)		STRENGTH IN (N/mm^2)	
					CC	FaL-G Concrete	CC	FaL-G Concrete
1	COMPRESSION	CUBE	7	18/02/2019	346.5	387.0	15.4	17.2
			14	25/02/2019	506.2	576.2	22.5	25.6
			28	11/03/2019	591.7	645.7	26.3	28.7
2	SPLIT TENSILE	CYLINDER	7	18/02/2019	127.9	137.8	s	1.95
			14	25/02/2019	151.9	175.3	2.15	2.48
			28	11/03/2019	179.5	198.6	2.54	2.81





B. Water absorption test

S.NO	% OF REPLACEMENT	INITIAL WEIGHT (KG)	OVEN DRY WEIGHT (W1)	WEIGHT AFTER IMMERSION (W2)	% OF WATER ABSORPTION
1	CC	8.41	8.30	8.55	3.01
2	FaL-G Concrete	8.32	8.11	8.51	4.93

VI. CONCLUSION

The demand for construction materials is increased nowadays. To bring down this problem, we are searching for new alternate materials. In the present study, Fly ash, Lime, and Gypsum (FAL-G) have been used as an admixture to cement in concrete manufacturing, and its collection and properties have been studied in phase I. An experimental study will check the strength and workability parameters of FAL-G concrete used in our project. For normal concrete, mix design is done based on Indian Standard (IS) method, and taking this as a reference design, mix design will be carried out to replace FAL-G concrete. The test results derived from FAL-G concrete will be cross-checked with normal concrete, and the end report will be furnished in phase II.

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